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Phosphoric Acid and Public Health*

What Happened in France During the Occupation When Phosphoric Acid Was Not Available

By VINCENT SAUCHELLI

Director of Agricultural Research, The Davison Chemical Corporation, Baltimore, Md.

PHOSPHORIC acid has been called the carrier of life. It is that. There is an old saying that "you never miss the water until the well is dry." The truth of that saying is strikingly brought out in what happened to France and other European countries during the recent war when overseas supplies of phosphates were cut off. During the entire five years of the German occupation, the amount of phosphates consumed by French agriculture was about equal to that of a single pre-war year. The proportion of soluble P_2O_5 dropped from 86 per cent in 1938–39 to 52 per cent in 1942–43. Because of the damaged railways following the June, 1944, landing, the distribution of phosphatic fertilizers was restricted to areas close to producing points. As a consequence of the war many French soils were completely deprived of phosphatic fertilizers from 1943 to 1947. Even the dung of livestock was more deficient than usual in phosphoric acid and the barnyard manure available was proportionately reduced in plant food value.

Alarmed by the lack of this essential element, many public leaders were able in 1946 to arouse enough interest in the problem to bring about an investigation. This was organized by the academies of science, medicine, agriculture and veterinary, farm organizations and the fertilizer industry. The facts revealed since then serve as a warning to all countries which deliberately or otherwise ignore the vital role played by phosphorus in maintaining the health and vigor of their people and livestock.

The investigators classified the results of phosphorus deficiency on the basis of plants, livestock and humans.

Plants

It was established that phosphorus deficiency decreased stooling in cereal grains, and therefore yields. Many of the soil types derived from granite had to be sown to rye because they could not support a wheat crop. New, heavy-yielding wheat varieties were unable to withstand freezing and, following the severe winter of 1947, over 2,000,000 acres of winter wheat had to be plowed under because of its damaged condition traceable to phosphate deficiency. Wheat on soils naturally rich in phosphorus was able to withstand the cold and to mature a good harvest.

Row crops did not show as severe damage as the cereals, but even in their case, both yield and quality deteriorated badly. In one department where comparative tests were run, phosphate-fertilized potatoes out-yielded the non-treated by about 10 per cent. Turnips in the same area grown under similar test conditions were very watery where phosphorus was omitted and cattle would not eat them.

In the Tarn-et-Garonne district, truck crops suffered severely, particularly melons. Growth

*The data used in this report were released by the Association de Propagande des Engrais Phosphates in France (N.S.).

was slow in getting started, maturing was retarded, pollination was poor, fruit was misshapen, flavor and color poor, and storage quality was inferior. These set-backs in quality and yield occurred on what are considered the best soils; the situation was worse on poorer soils which received no phosphates or animal manures.

Pastures and meadows ordinarily receive fairly heavy applications of lime and phosphates. With phosphates missing, the legumes died out and the herbage was reduced to weeds and poor grasses. Animal grazing on these phosphate-poor fields reflected the poor condition of the herbage. A remarkable improvement of quality in both herbage and livestock has been observed since 1946 when increased supplies of phosphate made it possible again to fertilize these fields.

A case of Osteo Malacia, or softening of the bones. The deformities caused by this disease are very evident in the forelegs.

Animal Hygiene

Vetreinary surgeons in France are agreed that the stock-raising districts which are prosperous owe their condition to the traditionally generous use of phosphates. The Limousin district, one of the best stock-breeding areas of the country, is a noteworthy example. Soft bones and other bone diseases in the livestock became prevalent throughout these formerly prosperous districts. "Mal-de-Champiegne" was the common name given to osteomalacia a generation ago; by 1939 the generous use of phosphate and lime had driven it from the district. Between 1942 and 1945 cases of osteomalacia and rickets reappeared. They are again on the wane now that phosphates have become available.

Wool clippings from sheep grazing on phosphorus-deficient fields showed a substantial decrease in weight amounting to as much as 56 per cent. Demineralization of the wool is attributable to a low phosphorus content of the pasturage.

Probably the most serious effects of low phosphorus supplies were experienced by animal breeders. Delay in sexual development, frigidity, failure to fecundate, abortion and non-delivery were among the many troubles reported.

The lack of phosphorus in the diet affects the health and vigor of humans.

Soft bones and other bone diseases become prevalent in stock raising districts.

Examples of such reports are the following:

"Cows are at present bred when two years old whereas before the war it was common to breed a 16-month-old heifer. Mares are also more than a year behind."

"Never have there been so many cows not in calf in spite of having been covered three or four times in succession under the most favorable conditions."

(Continued on page 30)

FERTILIZER PAPERS AT AMERICAN CHEMICAL SOCIETY MEETING

Abstract of Papers from Meeting of the Division of Fertilizer Chemistry, Atlantic City, N. J. September 19, 20, 21, 1949

Some Field Experiment With Fertilizer in Japan

C. L. W. Swanson, Department of Soils, Connecticut Agricultural Experiment Station, New Haven, Conn.

This paper describes field experiments with fertilizers on the major agricultural crops grown in Japan. Japanese agriculturists have conducted numerous fertilizer experiments with lowland rice, upland rice, wheat, covered barley, naked barley, sweet potato, mulberry, tobacco, and tea. Lowland rice has received by far the most attention. Data in this paper include experiments on lowland rice, upland rice, wheat, covered barley, naked barley, sweet potato, white potato, Satsuma orange, tea, and mulberry.

Methods used in Japan when carrying out fertilizer field experiments are generally not as refined as methods currently used in the United States and in some European countries. Field experiments are usually conducted on very small plots frequently less than a square meter (1.2 square yards) in area. Replication of treatment is often omitted and plots are established without any statistical design.

According to data obtained, nitrogen is by far the most important fertilizer nutrient influencing grain yield of both lowland and upland rice. Phosphorus and potassium also increase yields of these crops, especially upland rice. Optimum applications of these nutrients for lowland rice appear to range from 60 to 120 kg. (53.5 to 107.1 pounds per acre) of nitrogen, 20 to 60 kg. (17.8 to 53.5 pounds per acre) of phos phoric acid, and 40 to 80 kg. (35.7 to 71.4 pounds per acre) of potash per hectare.

Nitrogen also exerts the greatest influence on the yields of wheat, covered barley, and naked barley. Less effect is noted from phosphorus and potassium. Optimum applications for these crops appear to range from 80 to 140 kg. (71.4 to 124.9 pounds per acre) of nitrogen, 40 to 100 kg. (35.7 to 89.2 pounds per acre) of phosphoric acid, and 20 to 80 kg. (17.8 to 71.4 pounds per acre) of potash per hectare.

Results of field experiments indicate that potash is the most important fertilizer nutrient required for maximum production of sweet potatoes. For white potatoes, liberal applications of nitrogen, phosphoric acid, and potash are essential for high yields.

In a field experiment conducted in Shizuoka Prefecture, organic nitrogenous fertilizers appear to be superior to inorganic nitrogenous fertilizers in increasing the yield of tea leaves. For mulberry, however, inorganic sources of nitrogen were superior to organic sources. Nitrogen seemed to be the most important fertilizer nutrient required by mulberry trees to maintain high yields of leaves.

Some Properties of Fertilizer Conditioning Agents

John O. Hardesty and Rikio Kumagai, Division of Fertilizer and Agricultural Lime, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, Beltsville, Md.

Materials commonly used, or proposed for use, as conditioning agents for mixed fertilizers include a wide variety of plant residues, organic and inorganic waste by-products from various industrial processes, and a number of natural inorganic materials such as clay, diatomaceous earth, vermiculite, and rock dusts. These materials have been examined with respect to nutrient content, physiological acidity and basicity, apparent density, particle size, and equilibrium moisture content after storage under varying conditions of relative humidity and in contact with liquid water. The moisture values obtained afford a measure of the moisture absorbing capacity of the material. Different particle-size fractions of the same material showed considerable variation in apparent density and moisture absorbing capacity. The results as a whole show a wide variation in the chemical and physical characteristics of the different materials. The data serve to classify conditioning agents on the basis of

these characteristics and are preliminary to a study of the conditioning effect of materials as influenced by their physical and chemical properties.

The Molybdenum Content of Some Common Fertilizer Materials

H. E. Evans, E. R. Purvis, and F. E. Bear, Rutgers University, New Brunswick, N. J.

Because molybdenum deffciency has been detected in some soils in New Jersey, an investigation of the molybdenum content of the more common fertilizer materials appeared in order. Through the courtesy of the producers, samples of potash and nitrogen salts have been collected from a number of sources and analyzed for molybdenum by the thiocyanate colorimetric method. The results of these analyses are reported along with data relative to the molybdenum content of certain New Jersey crops and soils.

The Value of Visible Symptoms of Trace Element Deficiencies in Plant Growth

A. A. Nikitin

Information on the chemical analysis of soils, which has been used extensively for evaluating soil fertility, is not entirely sufficient. Study of the fertility of various soils shows that the relationship between the elements plays a more important role than the absolute value of each element by itself.

Visible symptoms on the plant foliage promise to furnish a successful method for estimating deficiencies on certain crops in relation to some trace elements. In this way it is possible also to recognize more readily the suitability of soil for certain crops.

Addition of elements deficient in the soil has been practiced very extensively in agriculture, and recently it was possible to secure much quicker response through foliage treatment with sprays or dusts. This method eliminates interference from the soil. As the response to foliage treatment is much more rapid than to soil treatment, the method promises to be particularly effective in protecting plants when deficiency symptoms have been discovered during early stages of growth.

Visible deficiency symptoms may be advantageously used, in specific cases, to evaluate the relationships which may exist between various elements important for crop production. Boron, in this case, may be used as an illustrative element, for it may be toxic to plants in the presence of a large amount of potassium. On the other hand, even larger amounts of boron in the soil may not cause any plant injury in the presence of a sufficient amount of calcium (lime).

By analytical methods, it would be impossible to secure sufficient information to establish this relationship between boron and calcium on various soils. Through the study of visible deficiency symptoms, however, a safe relationship between these elements may be secured.

Should Trace Elements Be Added to Commercial Mixed Fertilizer?

R. W. Ruprecht, Central Florida Experiment Station, Sanford, Florida

Trace elements should not be added to general commercial mixed fertilizer because they are not needed in the majority of soils, there is danger of applying toxic amounts, and quicker results with lesser amounts are obtained by spray applications.

Mineral Elements and Nitrogen in Manure Versus Manure

Jackson B. Hester, Department of Agricultural Research, Campbell Soup Company

A supply of dried animal manure was sampled and analyzed for the elements known to be necessary for plant growth. Tomatoes and other vegetable crops were grown under three separate conditions, (1) with a moderate application of ferilizer, (2) the same amount of the same fertilizer plus 2 tons of the dried manure, and (3) the same fertilizer plus the mineral elements and nitrogen from soluble equivalent to that of the manure were used as a sidedresser.

Greenhouse pot work with a Sassafras sandy loam and field plats with an Evesboro sand revealed an increase in yield on all crops except carrots through the application of manure and a better increase in yield with the mineral elements and nitrogen supplements.

Fertilizer Evaluation of Mono- and Diammonium Phosphates, by Means of Pot Cultures

W. H. MacIntire, S. H. Winterberg, A. J. Sterges, and L. B. Clements

The present study was prompted by lack of agreement as to the relative values of mono- and diammonium phosphates as fertilizers, by the fact that toxic effects upon roots systems have been attributed to the secondary phosphate, and by the fact that diammonium phosphate is not marketed as a fertilizer. The diammonium phosphate used in the pot cutlture study was a unique TVA product,

characterized by low vapor pressure, and was compared with nitrogen equivalences as mono-ammonium phosphate, ammonium nitrate, ammonium sulfate, ammonium hydroxide, sodium nitrate, and calcium nitrate, with compensation for PO_4.

In the first experiment, nitrogen input was at 50- and 100-pound rates. The mono- and diammonium phosphates were compared through the germination of rape and its growth on the Hartsells soil against respective equivalences of ammonium nitrate and concentrated superphosphate. At the 50-pound rate, the seedings showed no deleterious effects from the incorporations of either of the two ammonium phosphates, or from ammonium nitrate controls, and harvest repsonse was virtually equal for the three forms of nitrogen. Some detrimental effect was induced, however, by both of the phosphates of ammonium when they were placed in the zone of seeding. When the incorporations supplied nitrogen at the 100-pound rate, however, both of the phosphates proved decidedly injurious to germination and when placed in layers were still more repressive to germination and upon growth.

In a second experiment, the mono- and diammonium phosphates were equally effective on corn and cotton and, at nitrogen input rates of 16, 32, and 64 pounds, both phosphates were as efficacious as equivalent combinations of ammonium sulfate and concentrated superphosphate.

In the third experiment, the two phosphates were compared at various rates through crops of ryegrass and barley. Incorporated at rates of 32, 64, and 128 pounds of nitrogen per acre the two phosphates registered no detrimental effect upon the germination of either of the seedings and responses to the two phosphates were virtually identical to the responses to the respective controls.

It is concluded that, when they are incorporated at moderate rates, the two ammonium phosphates are equally effective as carriers of notrogen and phosphorus that can be used without injury to germination. From the foregoing evaluations, it is not to be inferred that the authors advocate the fertilizer usage of the two phosphates, as such.

Fertilizer Evaluation of Certain Phosphorous Materials

W. H. MacIntire, S. H. Winterberg, L. J. Hardin, A. J. Sterges, and L. B. Clements

Because phosphorous acid occurs in the concentrated orthophosphoric acid produced by means of the electric furnace and the production of the acid of higher content of phosphorus might prove economical, the fertilizer effectiveness of phosphorous acid, and of its compounds, was studied by means of greenhouse cultures. The materials used were phosphorous acid (H_3PO_3); calcium phosphite; two superphosphites, prepared through phosphorous acid acidulations of rock phosphate; three superphosphite-superphosphate mixtures, and H_3PO_4 and concentrated superphosphate for control. The ratios of PO_3 to PO_4 in the several phosphorous materials and mixtures were 1 to 0 in the phosphorous acid and in the calcium phosphite; 3 to 1 in the phosphorous acid and in the calcium phosphite; 3 to 1 in the superphosphites and in range between 1.3 to 1 and 0.22 to 1 in the superphosphite-superphosphate mixtures.

Imputs equivalent of 160 pounds of P_2O_5 per acre were incorporated into Hartsells fine sandy loam and Clarksville silt loam, unlimed and limestoned, and ryegrass, red clover, and alfalfa were seeded simultaneously. The initial crops gave virtually no response to phosphorous acid, in contrast to the findings that the effectiveness of H_3PO_4 was equal to that of superphosphate. Calcium phosphite was likewise ineffective and, in many instances, exerted a repressive effect upon plant growth. The response by the initial crops to the superphosphite were about half the responses to the superphosphate. The responses to the superphosphite-superphosphate mixtures became less as the proportion of phosphite was increased. When the ratio of phosphite to phosphate in those mixtures was as much as 0.22 to 1, the vegetative response was quite the same as the response to the concentrated superphosphate. In general, the plants obtained larger percentage content of phosphorus from the "ous" forms.

Apparently, the inherent oxidative capacity of the soil soon converted the "ous" compounds to other forms, since the responses by the second crops on the limed soils were virtually the same for all incorporations of phosphorus, regardless of the ratio of phosphite to phosphate.

The findings indicate that the small quantities of phosphorous acid that occur in "furnace" phosphoric acid impart no toxic properties to concentrated superphosphates obtained thereby and do not diminish the fertilizer effectiveness of such superphosphates. It is obvious that phosphorous acid could not be substituted for phosphoric acid to produce acceptable fertilizers.

(Continued on page 24)

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Phillips Chemical Announces Fertilizer Sales Appointments

A number of appointments to the newly organized fertilizer sales division of Phillips Chemical Company, a Phillips Petroleum Company subsidiary, have recently been announced by K. S. Adams, president of the parent company.

Harold R. Krueger, Director of Technical Service

Harold R. Krueger, who becomes director of technical service for the fertilizer division, has had 25 years of experience in the manufacture and sale of chemical fertilizers. Born in Pittsburgh, Pa., Mr. Krueger attended Jacksonville, Fla., public schools and studied chemistry at the University of Florida. He was foreman of the Jacksonville, Fla., plant of the American Agricultural Chemical Company for six years, was connected with the sales division of Atlantic & Gulf Fertilizer Company for two years and was plant superintendent of the Howard Fertilizer Works at Orlando, Fla., for three years.

For 12 years prior to joining Phillips, Mr. Krueger was production supervisor in the manufacture of commercial fertilizers for International Minerals and Chemical Corporation at Chicago. Mr. Krueger's headquarters will be located in Bartlesville, Okla.

Clarence J. Ball, Manager of Norfolk Sales Office

Clarence J. Ball will head the fertilizer sales office at Norfolk, Va. A native of Atlanta, Ga., Mr. Ball was with International Minerals & Chemical Corp. from 1920 to 1935. For the next 14 years, he was connected with Allied Chemical and Dye Corporation, serving as southern sales manager at Hopewell, Va., for the past several years.

The Norfolk office of Phillips Chemical Company will be in the Royster Building.

Kasper Peter, Manager of Chicago Sales Office

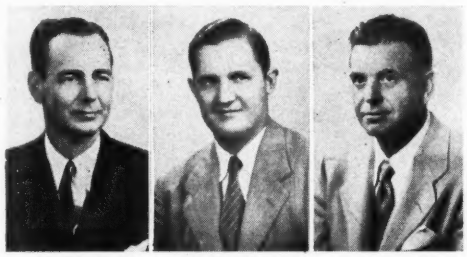
Kasper Peter, who has been appointed manager of the Chicago sales office, was born in Munich, Germany, and received his master of science degree in agriculture from the University of Munich in 1923. After arriving in the United States in 1924, he worked from 1925 to 1927 in the Bureau of Dairying of the United States Department of Agriculture at the University of Wisconsin.

Mr. Peter was connected with Midwestern fertilizer sales activities of Synthetic Nitrogen Products Corp. for four years and American

Cyanamid Company for 17 years before joining the Phillips organization. His office in Chicago is at 7 South Dearborn St.

R. D. Evans, Manager of Houston Sales Office

R. D. Evans will head the Houston, Tex., sales office of the fertilizer division. After graduating from Plainview, Tex., High School, Mr. Evans attended Texas A. and M. College where he received his degree in agriculture in 1940. Following a year as assistant county agent of Nueces County, Texas, Mr. Evans spent five and a half years in the United States Army. He survived the "Death March from Bataan" and spent the next three and a half years in Japanese prison camps.



A. W. Peck R. D. Evans C. J. Ball

Following his discharge from the Army 'Mr. Evans spent two years as director of the veterans-on-the-farm training program at Shreveport, La. Prior to joining Phillips, he was agricultural agent for the Missouri, Kansas & Texas Railroad.

The Houston district office of the fertilizer sales division is in the Commerce Building Addition.

A. Wayne Peck, Sales Representative

A. Wayne Peck has been appointed as sales representative in the anhydrous ammonia section, with headquarters at the home office in Bartlesville, Okla. A native of Tonkawa, Okla., he attended Northern Oklahoma Junior College, at Tonkawa, and Oklahoma City University.

Mr. Peck joined the Phillips staff in the research and development department in 1939 and was with the Philgas division at Amarillo, Tex., two years before starting a military leave of absence during World War II. He was attached to the Air Force as a civilian instructor in carburetion and supercharging equipment at Amarillo Army Air Field for two years.

Since the war he has been engaged as a manufacturer's agent in the liquefied petroleum gas marketing and equipment field.

New Jersey Fertilizer Conference

More than 100 fertilizer manufacturers and dealers are expected to attend the annual fertilizer conference at the College of Agriculture, Rutgers University, New Brunswick, N. J., on September 29th.

Among speakers will be Russell Coleman, president of the National Fertilizer Association, whose topic will be "The Role of Fertilizer in the Permanent Agricultural Program." Graham Campbell, of Cranbury, N. J., will speak on "Fitting the Fertilizer to the Farm."

Dr. William H. Martin, dean of the college and director of the Agricultural Experiment Station, will open the conference and preside. Topics will be presented by Dr. Firman E. Bear, Dr. E. R. Purvis and Harold Evans, all of the college's Soils Department. Dr. Stacy B. Randle, research specialist in chemistry at the college, will speak on "What the Fertilizer Law Requires."

Dr. Randle, who is handling reservations for the event, said anyone interested in fertilizers —farmers or persons connected with the industry—is welcome.

July Sulphate of Ammonia Production

The production of by-product sulphate of ammonia during July dropped slightly (about 5 per cent) from the June output, according to the figures of the U. S. Bureau of Mines. The output by the by-product producers consisted of 64,114 tons from coke-oven ammonia and 3,172 tons made from purchased synthetic ammonia. Shipments during July also dropped and, as a result, the end of the month showed producers' stocks on hand increased to 29,108 tons. Production for the first seven months of 1949 amounted to 494,783 tons, an increase of about 20,000 tons over the same period of 1948.

	Sulphate of Ammonia From By-Prod. Ammonia Tons	From Purchased Ammonia Tons	Ammonia Liquor Tons NH_3
Production			
July, 1949	64,114	3,172	1,843
June, 1949	67,579	3,521	2,030
July, 1948	70,242	2,800	2,107
Jan.-July, 1949	494,783	27,831	14,337
Jan.-July, 1948	472,815	16,547	14,213
Shipments			
July, 1949	56,240	3,187	1,126
June, 1949	60,759	3,707	1,252
July, 1948	63,062	2,844	2,050
Stocks on Hand			
July 31, 1949	29,108	....	919
June 30, 1949	21,841	....	702
July 31, 1948	32,885	....	497

Few Changes in North Carolina Official Grades

The 1949-50 fertilizer grade list for North Carolina, announced recently by Agriculture Commissioner L. Y. Ballentine, embraces only three changes over last year's grade list.

One grade, 10–6–4, was removed from the list as unnecessary and another, 0–12–12, was replaced by 0–14–14. One new grade, 16–8–2, was added on an experimental basis for use only on limited portions of tobacco plant beds.

Formulated by agricultural research specialists as a combination weed-killer and fertilizer, the new grade was proposed recently by Dr. W. E. Colwell, North Carolina Experiment Station agronomist, who said that it had proved economical and effective in experimental tests over a period of several years. A single application of this mixture in the fall, he explained, had achieved better results than existing methods of treating tobacco plant beds with a herbicide and later applications of plantbed fertilizer.

Specifications for the manufacture of 16–8–2 require that it derive its high nitrogen content from calcium cyanamid, 3.2 units, and from a urea source, 12.8 units. It is also specified that bags containing 16–8–2 carry a special tag instructing farmers how to use this fertilizer and warning them not to apply it to their entire plantbed yardage.

Commissioner Ballentine said the new fertilizer grade list had been approved by a majority of the members of the Board of Agriculture. It also follows recommendations agreed upon at a recent public hearing in Raleigh attended by representatives of the industry, the Experiment Station and the Department of Agriculture.

"All of the changes in this year's fertilizer list," he commented, "follow the trend toward higher formula goods, which mean more plant food value for the farmer's dollar."

The 1949–50 fertilizer list, containing 25 grades, follows:

For tobacco only: 2–10–6, 3–9–6, 4–9–3, 6–9–3, 5–5–20 (top dresser).

For tobacco and general crops: 3–9–9, 4–12–8.

For general crops: 0–14–14, 0–10–20, 0–9–27, 0–14–7, 2–12–12, 3–9–12, 3–12–6, 4–10–6, 4–12–4, 4–12–8, 5–10–5, 5–10–10, 6–6–12, 6–8–6, 7–7–7, 14–0–14 (top dresser), 10–0–30 (top dresser).

Experimental grade for tobacco plant beds only: 16–8–2.

Gran Resigns from American Plant Food Council Staff

Cedric G. Gran has resigned his position as assistant to the president of the American Plant Food Council, effective September 1st, according to an announcement from the Council's headquarters in Washington, D. C. Mr. Gran joined the Council staff in November, 1946. He is well known throughout the fertilizer industry for his wartime service as head of the agricultural chemicals pricing section of the Office of Price Administration. At the time he was employed by the Council, he was acting head of the grains, cereals and agricultural chemicals pricing branch.

Byrd Promoted by Spencer Chemical

Claude J. Byrd has been promoted to the position of assistant sales manager—agricultural chemicals of Spencer Chemical Company, according to an announcement by Joe E. Culpepper, assistant general sales manager. He has been fertilizer sales supervisor for the past year and earlier was sales representative for the company in Kansas, Oklahoma and Arkansas. Mr. Byrd will continue to make his headquarters in Spencer's executive and sales offices in Kansas City.

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NEW YORK

Shipment of Chemical Materials Against Contracts Continuing on Schedule. No Price Changes Reported. Organic Materials Show Lower Prices with Scarcity in Some Lines. Higher Prices on Imported Potash Meet Buyer Resistance.

Exclusive Correspondence to "The American Fertilizer"

NEW YORK, August 31, 1949.

Sulphate of Ammonia

Some export demand was noted but domestic orders were being shipped against contracts and no price changes reported. The production of synthetic material was said to be increasing.

Nitrate of Soda

This material was in good supply and buyers had no trouble in securing material necessary for their operations. Stocks on hand at various ports were fair.

Ammonium Nitrate

Buyers continued to take material on contract at prevailing prices and while the production has increased, a good market is obtainable for all the supplies available. No prices were noted.

Nitrogenous Material

Some producers are sold out for the balance of this year at prices ranging from $3.50 to $4.00 per unit of ammonia ($4.25 to $4.86 per unit N).

Castor Pomace

This material was a routine situation, with producers shipping against existing contracts and no new offerings reported. Last sales were made at $24.00 per ton. The demand continued good from all sections.

Organics

Tankage and blood were quiet the past week as well as other organic materials, with fertilizer buyers showing little interest. Last sales of tankage and blood were made at about $10.00 per unit of ammonia ($12.15 per unit N), f.o.b. shipping points, and most feed buyers were awaiting lower prices. Soybean meal for quick shipment was very scarce and sales were made as high as $100.00 per ton, f.o.b. Decatur, Ill., in bulk, with the feed trade taking most of the material. Linseed meal was slow, but there was a fair demand for cottonseed meal and offerings for prompt shipment were a little difficult to locate.

Fish Meal

This material was slightly stronger in price and reports were current that fishing was not up to expectations, due mainly to weather conditions. Last sales were made at $180.00 per ton, f.o.b. fish factories, and some plants still had considerable quantities to deliver on old contracts made at the beginning of the season.

Bone Meal

This is one material that is still difficult to buy, due to the small current production, with raw bone meal particularly hard to buy. Some imported feeding bone meal has been offered from time to time.

Hoof Meal

Some interest was shown in this material by fertilizer buyers, with last sales at $7.50 per unit of ammonia ($9.12 per unit N), f.o.b. Western production points.

Superphosphate

Triple superphosphate was said to be in better supply in some sections and regular 20 per cent material was available in good sized quantities. Some producers of regular super phosphate were curtailing production in order to be more in line with buyers requirements.

Potash

Several offerings of foreign material were made at prices in excess of domestic material, which were passed up by the buyers. Domestic producers continued to ship to buyers on contract.

PHILADELPHIA

Better Interest in Materials Expected after Summer Ends. Effect of Steel Strike on Sulphate Production Feared.

Exclusive Correspondence to "The American Fertilizer"

PHILADELPHIA, August 29, 1949.

Raw materials are not in great demand at this time, but the situation is bound to improve during the fall months. The trade does not seem seriously disturbed over the threat of a Congressional investigation of the harmful effects of present-day fertilizers, etc.

Sulphate of Ammonia.—Demand is fairly steady and market is firm, with production well under contract. However, some concern is felt for the future production, should a strike eventually develop in the steel industry. A brisk export inquiry is reported.

Ammonium Nitrate.—Considerable activity is reported with deliveries moving in considerable volume.

Nitrate of Soda.—Seasonal lassitude prevails and any movement is principally for top dressing. No price changes are indicated.

Blood, Tankage, Bone.—Blood has been in moderate demand at $10.00 per unit of ammonia ($12.15 per unit N) in New York, and $10.50 ($12.76 per unit N) in Chicago. The demand for tankage has eased somewhat, with quotations same as blood. Bone meal continues in greater demand than supply and is quoted more or less nominally at $65.00 to $75.00 per ton, depending on the grade. Hoof meal is quoted at $7.50 per unit of ammonia ($9.12 per unit N), Chicago, with supply quite limited.

Castor Pomace.—Production is considerably reduced and shipments are confined to contracts made some time ago.

Fish Scrap.—Large catches have improved the supply position, but price remains at about $165.00 per ton for scrap, $175.00 for 60 per cent menhaden meal, and $180.00 for 65 per cent grade.

Phosphate Rock.—Demand is reported as seasonally fair, with sufficient stocks to meet all requirements.

Superphosphate.—Supplies are ample, demand is rather weak and shipments not too active. Production during the first half of 1949 is said to have dropped below the same period last year as much as 3½ to 4 per cent.

Potash.—Market is firm and shipments are ahead of last year, due to increased production. Present movement is mostly against contracts made earlier. Offerings from Europe are still too high priced.

CHARLESTON

Chemical Materials Should Be in Good Supply. Organics Scarce and Priced Above Fertilizer Levels. Superphosphate Output Lower.

Exclusive Correspondence to "The American Fertilizer"

CHARLESTON, August 29, 1949.

Except for organic sources of nitrogen, supplies of the three prime ingredients—nitrogen, phosphates and potash—are expected to be sufficient to meet the demand during the new season, although potash in certain sections may be a little short.

Organics.—Interest in organics for fertilizer use has improved recently as the new mixing season approaches. Castor pomace is in tight supply and nitrogenous tankage producers are heavily sold, with additional supplies relatively short. Nitrogenous tankage is priced at $3.15 to $4.00 per unit of ammonia ($3.83 to $4.86 per unit N), in bulk depending on the producer, with a tendency towards higher prices within this range.

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Castor Pomace.—The price of castor pomace is nominally $24.00 per ton f.o.b. northeastern production points, in bags, with practically no offerings in the market. Current movement is against existing contracts. Some castor pomace has been indicated at $32.00 to $38.00 per ton, c.i.f. Atlantic ports, for shipment from abroad, but no sales have been noted.

Dried Ground Blood.—This material is reported easier in price at $9.00 per unit of ammonia ($10.94 per unit N) in bulk in the New York area, with the Chicago market at around $10.50 ($12.76 per unit N), but these prices are too high to interest fertilizer buyers.

Potash.—The market is firm with the expected production heavily under contract. Demand continues strong and some buyers still do not have contracts to completely cover their expected needs. No change in prices has been noted.

Ground Cotton Bur Ash.—This material containing 28 per cent to 31 per cent K_2O is obtainable at around 75 cents per unit of K_2O in bulk carload lots, f.o.b. Texas shipping point.

Phosphate Rock.—August deliveries are reported somewhat down compared with July, but this is probably seasonal. Stocks continue adequate to meet expected demand. No change in prices has been noted.

Superphosphate.—June production is reported at 707,000 short tons, which is approximately 13 per cent less than the May, 1949, production. Production is expected to be adequate to meet the demands for the new season. Prices are steady.

Sulphate of Ammonia.—The market on coke oven sulphate of ammonia continues firm with the steel mills heavily sold. Synthetic production varies in price from $45.00 to $48.00, depending on the point of production.

Hoof Meal.—This excellent organic source of nitrogen is around $7.50 per unit of ammonia ($9.12 per unit N), f.o.b. Chicago.

Nitrate of Soda.—No change in the supply or price situation has been noted on nitrate of soda. Demand is seasonal and supplies for the new year are expected to be adequate.

CHICAGO

Sharp Drop in Prices on Organic Materials with Possibility of Further Declines Later.

Exclusive Correspondence to "The American Fertilizer"

CHICAGO, August 29, 1949.

For the first time in several months the market on animal ammoniates in the Middle West suffered a sharp decline and at present is in a rather weak position. Up to this writing the value of unground materials has not kept pace with the declines in finished product and it is anticipated that unless a better demand for the finished goods develops soon, the prices of unground goods will have to decline further.

Meat scraps during the past two weeks have dropped to the extent of $35.00 per ton and 50 per cent protein product is now listed at $130.00 per ton, but sales are reported as low as $125.00 per ton. Digester tankage is similarly lower with a list price of $150.00 per ton, but buyers' views are $5.00 to $10.00 per ton lower on limited quantities.

Dry rendered tankage is freely offered at $2.50 per unit of protein, delivered, but this price is considered too high and some sales are reported as low as $2.35 with bids generally quoted at $2.25. Wet rendered tankage is nominally quoted at $11.00 to $11.50 per unit of ammonia ($13.37 to $13.98 per unit N) for high testing goods and low test product approximately $1.00 higher. Blood last sold at $10.50 per unit of ammonia ($12.76 per unit N) delivered. Steamed bone meal, 65 per cent, is nominally steady at $75.00 per ton and raw bone meal at $65.00 per ton.

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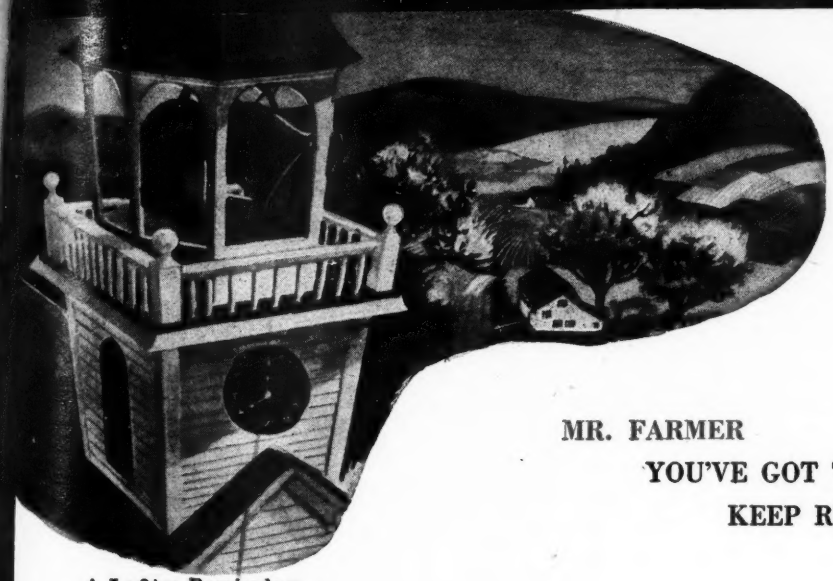
Mr. Fertilizer Packer: HERE'S A LETTER WE'RE SENDING TO FARMERS



MR. FARMER
YOU'VE GOT TO
KEEP RINGING!

A Lofty Reminder —

We know a little village, something like the one pictured here. You could almost say it was built around a church. For that church is the center of everything. It has been that way for over a hundred years. You'd think no one would need to be reminded of it. Yet, regularly every Sunday they still ring the bells!

That's the point, of course. Nothing can be taken for granted, ever. That's why we're writing again, reminding you about St. Regis Multiwall Bags.

There's a dozen reasons why you ought to order fertilizer in these strong kraft paper bags. But the one that makes the most sense is that it saves wear and tear on the man who has to handle them.

They're half the weight and lessen the danger of strain or rupture. They're strong, compact, dry, full weight and free flowing. They protect against sudden showers. You can even toss them into your car and they won't sift.

Yes, they're that good! And they don't cost a cent more. Once you've used them we promise you won't need to be reminded again.

Cordially,

John F. Gruber
Vice President

THIS actual letter, and others like it, are being sent *regularly* to farmers in certain areas, to make sure they know the many advantages of strong, economical, easy-to-handle St. Regis Multiwalls.

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Allen Celebrates 60 Years with Bemis Bag Co.

An outstanding record of company service has been set by Henry H. Allen, vice-president and a director of Bemis Bro. Bag Co., who recently celebrated his 60th year with Bemis. Mr. Allen is in charge of Bemis' eastern operations with headquarters in New York.

This long career in the bag industry started, in a sense, when Mr. Allen was a child. His father moved the family from their home in Omaha and settled in Rochester, N. Y.—then known as "The Flour City"—to manufacture paper bags for the flour mill at the falls of Genesee River. One of Mr. Allen's earliest recollections is of the crew of workers "hand-forming and hand-making paper bags for flour" in his father's factory, located in the loft of a three-story building.

His active association with the bag industry started in 1889 when Mr. Allen returned to Omaha and joined the Bemis organization there. Two years later he was made superintendent of the Omaha plant.

After nine years of production work, he went to the St. Louis plant as a salesman and was later transferred to the Kansas City sales force. When a factory was built in Kansas City in 1903, Mr. Allen was made manager and stayed in that position until 1911 when he became manager of the St. Louis plant. A year later he was elected secretary of the company and to membership on the board of directors.

In 1920 Mr. Allen's experience was again called upon when he was sent to Brooklyn to take charge of the new Bemis plant being built there. He was made a vice-president in 1921 and some years later transferred his headquarters to New York City.

Lion Oil Promotes Donald

A. F. Reed, vice-president in charge of sales of Lion Oil Company, has announced that, effective September 1st, Leroy Donald has assumed the position of administrative assistant (chemical sales) to the vice-president. Mr. Donald has served as chief agronomist since becoming associated with the company in June, 1948.

Before coming with Lion, during the period from 1936 to 1945, he had risen from district agriculturist to chief agronomist for the Barrett Division of Allied Chemical & Dye Corporation. Mr. Donald received his pre-college training in the grammar and agricultural high schools of Goodman, Miss., and holds Bachelor of Science (General Agriculture 1927) and Master of Science (1928) degrees from Mississippi State College. Following this, he served as instructor at the University of Wisconsin and in 1929 he returned to Mississippi State as associate professor in the Department of Botany.

June Superphosphate Production Drops

Less superphosphate was produced in the United States during June than during either May, 1949, or June, 1948. Figures compiled by The National Fertilizer Association and a summary of figures compiled by the Bureau of the Census reveal a total output during June, the latest month for which figures are available, of 809,000 equivalent short tons (basis 18 per cent A.P.A.). This amount represents a drop of approximately 14 per cent from the production figure reported for the previous month and of 2.5 per cent from the quantity recorded for June, 1948.

Normal superphosphate (basis 18 per cent A.P.A.) accounted for approximately 87 per cent of the June total, while the concentrated type (basis 45 per cent A.P.A.) accounted for all but 2,300 tons of the remainder. The latter figure is the quantity of wet base goods (18 per cent A.P.A.) turned out during the month.

Stocks held by acidulators at the beginning of June totaled 822,000 equivalent short tons of 18 per cent superphosphate; the addition of the June output to these stocks resulted in a total supply of 1,654,000 short tons. Of this amount, 387,000 tons were shipped and

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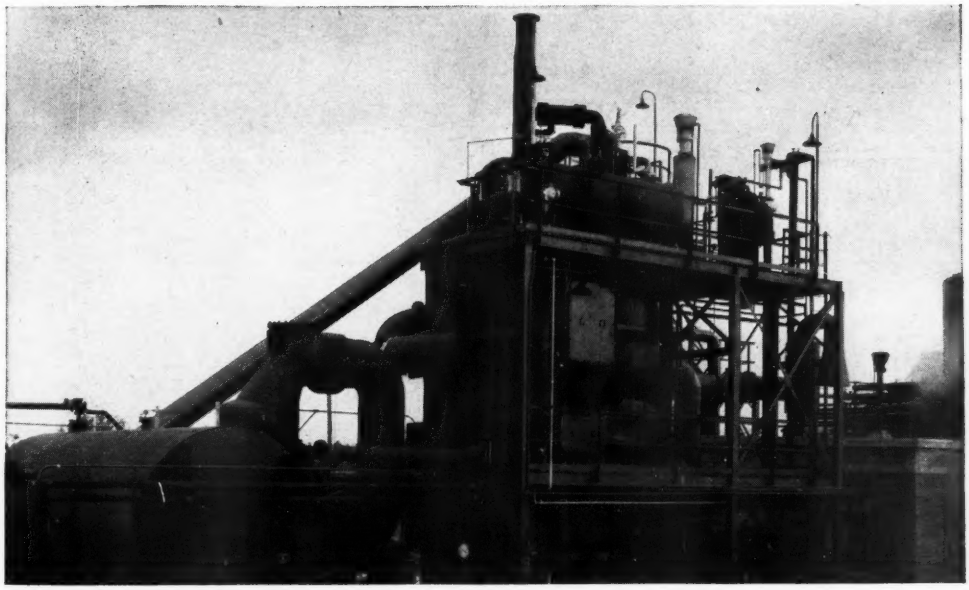

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314,000 tons were used in the reporting plants in the making of mixed goods, leaving stocks on hand at the end of the month of 953,000 tons.

The 5,458,000 equivalent short tons produced during the first half of 1949 represented a decline of about 200,000 tons or 3.6 per cent from the January-June, 1948, output.

	Normal 18% A.P.A.	Concentrated 45% A.P.A.	Base Goods 18% A.P.A.
Production	Tons	Tons	Tons
June, 1949	706,690	39,875	2,303
May, 1949	809,108	46,181	4,321
June, 1948	736,246	36,002	3,044
Shipments and Used in Reporting Plants			
June, 1949	600,445	39,452	1,799
May, 1949	821,254	39,757	3,152
June, 1948	555,176	45,994	1,792
Stocks on Hand			
June 30, 1949	761,700	75,010	3,730
May 31, 1949	648,587	68,253	3,194
June 30, 1948	1,186,597	49,627	3,335

Dow Plans New Ammonia Plant

Dow Chemical Company, Midland, Mich., is planning the construction of a new $5,000,000 anhydrous ammonia plant at Freeport, Tex., according to Leland I. Doan, president. The plant is expected to have a capacity of approximately 100 tons per day.

Field construction is scheduled to start about January 1st, and it is expected that the plant will be in operation late next year. It will use hydrogen from the company's chlorine plant in Freeport for the production of anhydrous ammonia by the Haber-Bosch process.

Hough Issues Fertilizer Job Study

A study of fertilizer material handling problems has been published by the Frank G. Hough Co., Libertyville, Ill., manufacturers of the Payloader line of portable loading shovels. Based on a survey of results obtained from the use of modern equipment at the plant of the Independent Manufacturing Co., Philadelphia, Pa., the bulletin will be of interest to every fertilizer manufacturer. A copy can be obtained by writing to the Hough Company, requesting Job Study No. 13.

New Fertilizer Distributor Booklet

A new, 24-page, picture-packed booklet describing new methods of fertilizer application and seeding operations, has just been published by the Power Production Company of Chicago, manufacturers of the Ezee Flow line of fertilizer spreaders and seeders. The informative booklet pictures and describes new methods and equipment developed to reduce seed and fertilizer waste during application, and save time, labor and costs on spreading and sowing operations. In addition, several pages in the booklet contain important fertilizer data, show how to establish profitable, soil-building rotations, and how to protect farm land from serious losses by soil erosion. A free copy may be had without obligation by writing to the Power Production Company, Dept. E, 10 S. LaSalle Street, Chicago 3, Ill.

Corn Price Support Program for 1949 Crop

The U. S. Department of Agriculture announced on August 22nd, that 1949-crop corn will be supported by the Commodity Credit Corporation at 90 per cent of the corn parity price as of October 1, 1949, by farm-storage and warehouse-storage loans and by purchase agreements.

Except as provided below, loans and purchase agreements will be available from time of harvest through May 31, 1950, and will mature on July 31, 1950. Producers who elect to deliver corn under a purchase agreement must notify their county conservation committee within a 30-day period before maturity.

In areas where producers cannot store corn safely for the full storage period because of climatic conditions, insect infestation, or other factors affecting safe storage, the loans and purchase agreements will be available from time of harvest through a date earlier than May 31, 1950, as may be determined by State Production and Marketing Administration Committees. In these instances, the delivery dates for farm storage loans and purchase agreements also may be advanced, but no ad-

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vance will be made in delivery dates for warehouse storage loans.

Corn placed under loan must, except for moisture content, grade U. S. No. 3, or better, or No. 4 on test weight only, and meet the moisture requirements for safe storage. Corn delivered under a purchase agreement must grade U. S. No. 3 or better, or No. 4 on the factor of test weight only.

A. C. S. FERTILIZER PAPERS

(Continued from page 11)

Problems and Chemistry of Direct Application of Anhydrous Ammonia to the Soil

W. B. Andrews and Marvin Geiger, Mississippi Agricultural Experiment Station, State College, Miss.

Anhydrous ammonia was introduced to the farmers of Mississippi on March 7, 1947 and by June 30 90,000 acres had been fertilized with it; from July 1, 1947, to June 30, 1948, 500,000 acres were fertilized with it; and from July 1, 1948, to June 30, 1949, about 1,000,000 will be fertilized with it.

In this territory, anhydrous ammonia is being used in considerable quantities in Arkansas and Louisiana, and to a small extent in Alabama, Missouri, Tennessee, and Texas, with a very small amount being used in Georgia and a few other states.

When anhydrous ammonia is applied to the soil, it combines with the clay and organic matter making solids. Ammonia replaces hydrogen easily, and it may replace other cations. Calcareous soils hold ammonia readily, which is probably due to the depth of application. Ammonia is used directly by plants, or it is converted into nitrates. In general young plants prefer ammonium nitrogen, and older plants prefer nitrate nitrogen. So long as nitrogen is in the ammonium form, it does not leach; after it is converted into nitrate nitrogen, the nitrogen is subject to leaching.

The pH of the soil is one of the primary factors which determine the rate of nitrification. On soils with a pH of 5 or less, the rate of nitrification is slow, and anhydrous ammonia may be applied in October to fall planted oats for grain, and the results obtained are equal to those for ammonium nitrate applied in March. On soils with a pH of 5.5 or higher, the rate of nitrification is high and anhydrous ammonia applied in October is converted into nitrates and largely leached out of the soil before spring.

When applied to fall planted oats in January, anhydrous ammonia is satisfactory on strongly acid soils; however, when applied to soils of pH 5 or less in early March, the rate of nitrification is too slow for oats to make maximum utilization of the nitrogen, but when applied to soils with a good supply of lime, nitrification is rapid and oats utilize it efficiently.

The liquid phase of anhydrous ammonia, in equilibrium with the gas phase, is at its boiling point at all temperatures, and it boils if the pressure is reduced. For this reason it does not behave as a liquid, nor as a gas, which must be taken into consideration in metering it.

There are four ways of metering anhydrous ammonia on tractor equipment: (1) regulating valve and pressure gages, (2) needle valve and pressure gages, (3) rotameter, and (4) pump.

The first three are metered with time; the last one is geared to the tractor. With the regulating and needle valves and associated pressure gages, the rate of ammonia delivered is a function of tank pressure and orifice pressure, which can be determined. With the rotameter and pump, the incoming ammonia must be cooled by the outgoing ammonia to prevent bubbling; except in experimental work using a rotameter a cooling device is undesirable.

Further Observations on the Preparation and Properties of Urea-Form

K. G. Clark, J. Y. Yee, K. S. Love, and T. A. Boyd, division of Fertilizer and Agricultural Lime, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, Beltsville, Md.

The character of the product resulting from the reaction of urea and formaldehyde and the rate of reaction are determined largely by the molecular proportions of the reactants, the pH of the reacting mixture, and the

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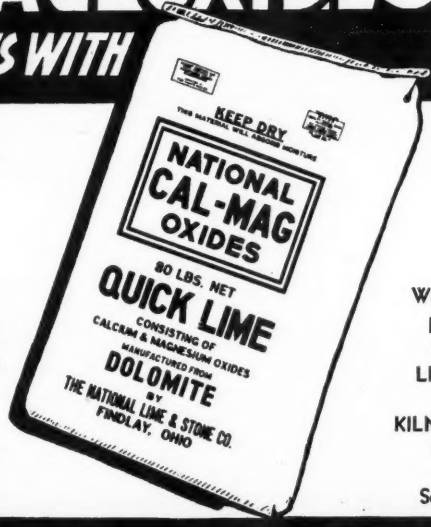

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temperature at which the reaction is carried out. Increasing the initial proportion of urea decreases the rate of reaction and produces a material with a higher urea-formaldehyde mole ratio and solubility. Decreasing the initial pH of the reaction mixture increases the rate and temperature of the reaction and yields a product with lower mole ratio and solubility characteristics.

Products prepared from dilute solution under acidic conditions at temperatures only slightly above normal contain little unreacted urea and are relatively stable toward moderate thermal treatment in the dry condition. When moistened and slightly acidified, however, such products undergo condensation or polymerization with a proportionate decrease in the ureaformaldehyde mole ratio and increase in the free urea content. Products prepared from concentrated solutions normally contain somewhat larger quantities of unreacted urea and retain the buffering or acidifying agents used to promote the reaction. These products may be more or less stabilized toward subsequent temperature increases by leaching out the acidifying agent and unreacted urea, by subjecting the moist material to temperatures above those which will be encountered later, or by neutralization of the acidifying agent. Following neutralization the product may be subjected to further thermal treatment without appreciable change in its mole ratio and solubility characteristics. Neutralization also may be employed to interrupt the reaction at a desired stage and to minimize polymerization during normal cooling and drying operations.

Inasmuch as urea-formaldehyde reaction products are mixtures of several molecular species, determination of the ureaformaldehyde mole ratio and a single solubility measurement are not adequate for estimation of the probable agronomic availability. Presently successive solubility measurements on an individual sample together with the mole ratio are used for this purpose.

Cyanamide and Related Compounds in Agriculture

Frank L. Stark, Jr., and Delmar S. Fink, American Cynamid Co.

Calcium cyanamide and related compounds —namely, mono-sodium cyanamide, ammonium thiocyanate, potassium cyanate, and sodium cyanide—are finding widespread utility in the agricultural field. The adaptation of any particular compound for a specific purpose is usually as closely related to the physical chemical properties of the compound as to its physiological effects. Consequently,

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it is essential that the physical chemical properties of any compound are fully considered in selecting experimental compounds for use under various environmental conditions, in developing the optimum methods and time of applying the chemicals, and in interpreting the results of a given treatment. Calcium cyanamide, for example, is a crude material which requires water for the formation of its toxic principle, free cyanamide (H_2CN_2). This reaction normally occurs slowly, and consequently, it is necessary for herbicidal or defoliation action that this chemical be applied when free moisture is or will be present on the plants for 30 minutes or more. Sodium cyanamide, on the other hand, is proving more effective than calcium cyanamide under semiarid conditions because its hygroscopic nature brings about the adsorption of moisture from the microatmosphere at the surface of the leaf and causes rapid solution of the toxic principle.

The chemical reaction which compounds undergo on contact with the soil can also influence their utility. For example, potassium cyanate which is proving effective for the selective weeding of various crops is safe to use because, among other reasons, it rapidly breaks down to nontoxic compounds on contact with acid soils, thereby having no residual toxicity. In turn this rapid breakdown or detoxification precludes the use of this chemical as a soil treatment for the control of ungerminated weed seeds. On the other hand, calcium cyanamide, which reacts more slowly in the soil and passes through a free cyanamide stage, which is toxic, with the subsequent formation of urea, is very effective for the killing of weed seeds in the soil.

Nonfarm Use of Fertilizers in the United States, 1947-48

Walter School and Hilda M. Wallace, Division of Fertilizer and Agricultural Lime, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, Beltsville, Md.

A survey was made of the use of commercial fertilizers on home gardens, golf courses, and cemeteries and for other similar nonfarm purposes. It is estimated that in the year ended June 30, 1948, the United States used 343,218 tons for such purposes, of which 138,481 tons consisted of mixed fertilizers and 204,737 tons of separate materials. In addition 130,000 tons of peat were also used.

About 1 per cent of all mixed fertilizers and 4 per cent of all materials used separately were consumed by others than farmers.

California used 116,173 tons, or the largest quantity for any state, for nonagricultural purposes. This is 9.66 per cent of the state total. Seven other states each used more than 10,000 tons, 11 between 5000 and 10,000, 18 between 1000 and 5000, and the other 12 less than 1000 each.

The use of the three leading grades was 5–10–5 31,955 tons, 4–12–4 30,249 tons, and 6–10–4 24,620 tons. These three grades constituted 62.7 per cent of the total for 218 grades for nonfarm uses. Dried manures and sewage sludges represented more than one half of the tonnage of separate materials.

Most fertilizers used for nonfarms are prepared from the same materials as farm fertilizers. A number of these fertilizers also contain hormones, vitamins B_1 and B_2, and 2–4–D for weed control.

Tablets are usually made from chemicals such as diammonium phosphate and potassium nitrate and thus generally contain from 45 to 70 per cent plant nutrients.

Speciality fertilizers contained 17,286 tons of nitrogen, 21,462 tons of available P_2O_5 and 9695 tons of K_2O. The peat used for soil improvement provided 2600 tons of additional nitrogen.

Potash Production, a Progress Report

J. W. Turrentine, American Potash Institute, Washington, D. C.

The American potash industry during the calendar year of 1948 maintained its record of progress with increased production and sales, a record now unbroken since 1938.

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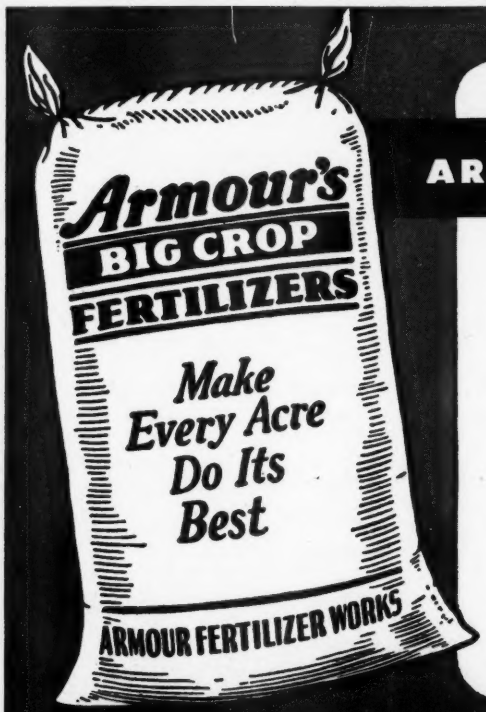

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Potash deliveries during 1948 amounted to 2,134,000 tons of potash salts equivalent to 1,134,000 tons K_2O, the output of five leading producers and representing some 300 per cent increase during the past ten years.

While the well-known and now standard grade, 98 per cent potassium chloride ("60 per cent muriate" of the trade) made up 80 per cent of the total, other grades such as the 50 per cent K_2O granular muriate, potassium sulphate, sulphate of potash-magnesia, and run-of-mine salts were also provided to supply an ever-growing agricultural demand. Also during the year the chemical industries were supplied with the specially refined chloride and sulphate amounting to some 142,000 tons of salts, included in the above total.

PHOSPHORIC ACID AND PUBLIC HEALTH

(Continued from page 8)

So acute has been this situation that the French government horse-breeding establishment at St. Jean de Liversay resorted to practice of feeding the stallions a daily dose of eight tablespoonfuls of a phosphoric acid preparation.

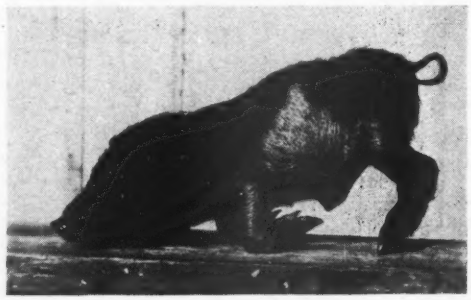
Milk

The quality and yield of milk also suffered. This was to be expected since phosphorus is an important ingredient of milk and is essential in the cow's metabolism. An average of about 30 per cent decrease in milk output was reported. Accompanying the drop in milk production was a drop in fat and consequently in butter. This shows how intimately phosphorus is linked in bodily processes with the formation of fats. Demineralization of the milk lowered the output and quality of cheese. In many parts of the cheese-making districts it was necessary to add lime to the milk to get it to curdle.

Human Health

Leading health authorities have always stressed the importance of a balanced mineral ration in the human dietary. The lack of phosphorus in the diet of plants and animals in a country like France during the occupation when food imports were shut off could not help affect the health of humans forced to depend upon domestic food supplies. People went to the drug store for their phosphorus; the use of medicines containing calcium phosphate and phosphoric acid increased by 25 to 30 per cent over pre-war levels.

Physicians who before the war attributed soft or brittle bones to a lack of calcium alone now are convinced that phosphorus as well as calcium is involved in the formation of healthy, normal bones. Numerous French professors of high standing reported a big increase in bone fractures and dental decay among adults, and among children a lower intellectual capacity, and an increase in decalcification and in scoliosis. Since 1946 when phosphate again became available to farmers, bone fractures and diseases have decreased considerably, reflecting the favorable influence of phosphates on human health.



Weak bones in a boar.

Conclusion

These reports and observations of the vital role played by phosphorus in human, animal and plant life serve to remind us, who are blessed with adequate supplies of phosphorus, that we should not take this element for granted. They also should give the phosphate mining and phosphate processing industries and the fertilizer industry a greater sense of social responsibility in the job of supplying phosphorus to the nation. On the other hand these observations also indicate what an enviable opportunity these phosphate industries have in basing a public relations campaign on how they serve to keep people strong, healthy and happy.

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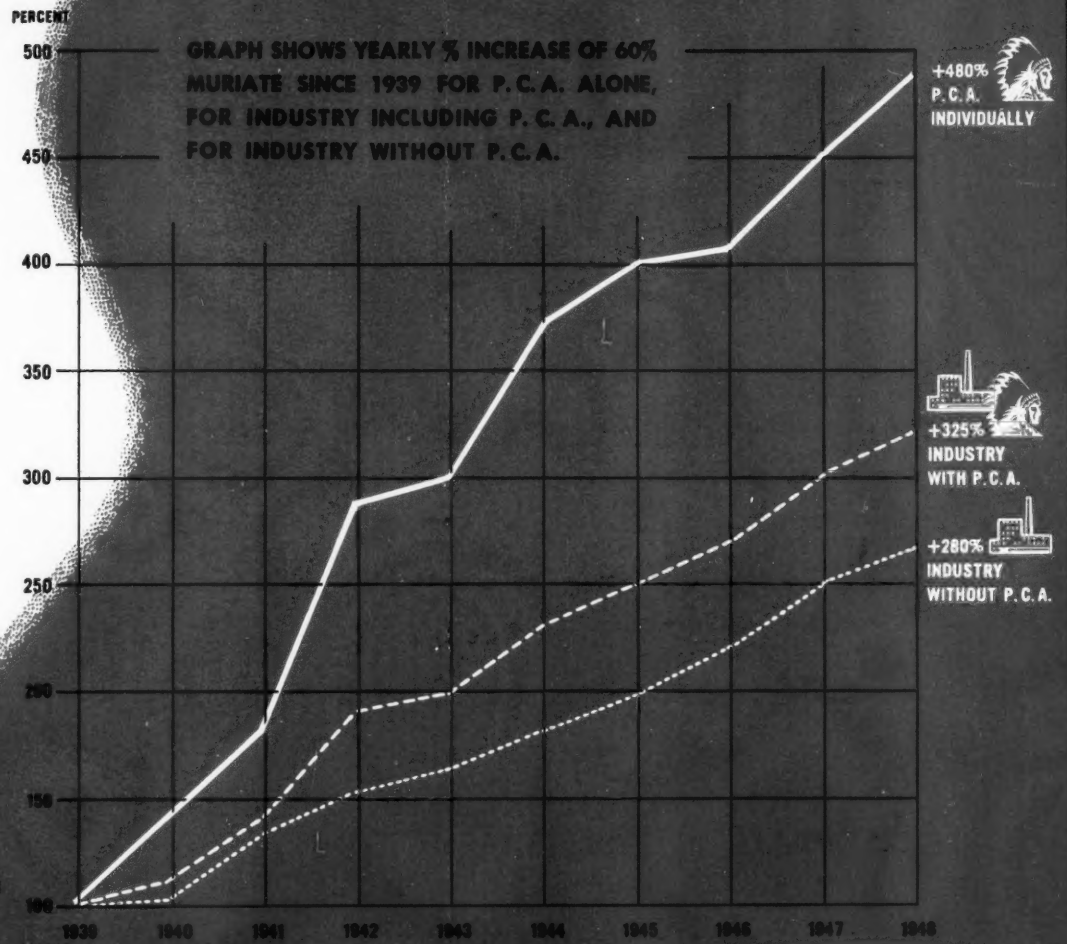

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